DoD Executive Agent

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NDCEE

National Defense Center for Environmental Excellence

Operated by:

CTC Concurrent Technologies Corporation

Transferring Technology Solutions -

Corn Hybrid Polymer (CHP) Blast Media – Coatings Removal from Delicate Substrates

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Supporting Readiness, Sustainability, and Transformation

Presentation Outline

- Background
- Objectives
- Technology Overview
- Baseline Activities
- Proof-of-Concept Evaluation
- Economic Analysis
- Demonstration
- Implementation
- Path Forward

Background

- Coatings removal and selective stripping techniques are performed routinely during maintenance, repair, and overhaul activities
- Current processes include chemical strippers, media blasting, and manual coating removal methods that often result in:
  - Substrate damage
    - Unnecessary rework
    - Reduced part life
  - Solvent vapor release
  - Hazardous waste generation
  - Unsafe working conditions
- Past efforts evaluated several alternative coating removal technologies
- Corn-based blasting media
  - Provides acceptable stripping rate
  - Does not damage delicate substrates
  - Generates biodegradable and non-hazardous waste
  - Adheres to Department of Defense (DoD) environmental, pollution prevention, and toxic chemical use reduction requirements
    - Executive Order (EO) 13148, Section 401 of EO 13101

Objectives

- Evaluate corn-based blasting media for removing coatings from delicate substrates
  - Evaluate overall coating removal efficacy and cost feasibility
  - Determine if the process meets stakeholder requirements
- Identify approval authorities and implementation paths for corn-based blasting media at DoD facilities
- Determine feasibility and help facilitate field implementation

Technology Overview/Process Methodology

- Corn Hybrid Polymer (CHP) media (eStrip™ GPX)
  - Polycrystalline cornstarch material
  - 100% organic, non-toxic, and biodegradable.
  - Pressures range from 20-35 psi
  - Used in standard light abrasive equipment
  - Considered a “drop-in” replacement for many plastic media blasting (PMB) systems
    - Meets MIL SPEC for Type VII PMB
  - Generates minimal waste
  - Manufactured by Archer Daniels Midland (ADM)
  - Solely distributed by Midvale Environmental Technologies

CHP media is being used to remove the coating system from a C-130 spinner cap. The CHP is visible in the bottom-center of the photograph.

Technology Overview/Process Methodology

Midvale's mobile demonstration facility

The mobile facility includes a fully enclosed blast room, media delivery system, material recovery system, and personal protective equipment

- During demonstrations, all coatings removal activities conducted inside of Midvale's mobile demonstration facility
- Media recovered inside of the mobile facility and then disposed of by host facility personnel or Midvale

Accomplishments and Results

- Conducted baseline surveys at NADEP-Cherry Point, NADEP-Jacksonville, Robins AFB, Naval Station Mayport, and Kings Bay NSB to collect information related to their existing coating removal processes for delicate substrates
- Completed coating removal evaluation at Robins AFB (funded by Navy, but leveraged under this task) to assess the performance of CHP on C-130 radomes, C-130 spinner caps, and F-15 speed brakes
  - Positive preliminary results obtained from Robins AFB personnel
- Completed proof-of-concept evaluation at Naval Station Mayport
  - Navy, Air Force, and NASA personnel in attendance
  - Calculated and recorded coating removal rates and stakeholders' visual observations respectively
  - Components that were evaluated included:
    - C-130 spinner cap
    - F-15 speed brake
    - MK-92 radome
    - P-3 radome
    - HMMWV hood
    - PCMS tiles
    - SH-60 helicopter blade
    - NASA Windbrake panels
    - T-45 speed brake
    - EP-3 blade antenna
    - F-18 antenna cover
    - Surface ship life raft shell
    - Gas turbine engine bullet nose

CHP coating removal of CARC topcoat on HMMWV hood (left) with primer remaining on the undamaged fiberglass substrate (right)

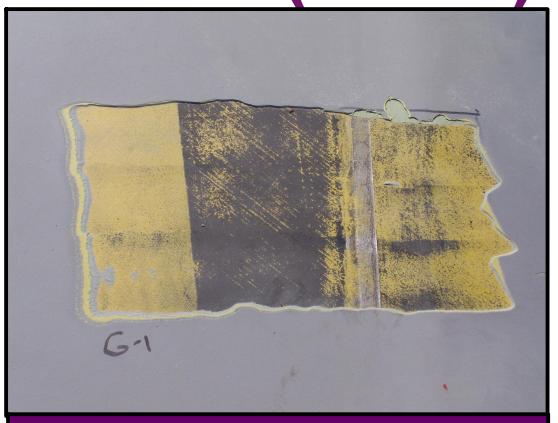
Accomplishments and Results (cont.)

- Sampling of results from proof-of-concept evaluation:

Component	Coating System	Substrate	BASELINE PROCESS			CHP		
			Process	Strip rate (ft^2/hr)	Comments	Nozzle Pressure (psi)	Strip rate (ft^2/hr)	Observations
C-130 Spinner	Surface primer with polyurethane erosion resistant coating (7-9 mils total)	Fiberglass with electrical wires embedded	Hand Sanding	0.6	Significant damage to substrates and wires embedded within	35	9.8	Coating removed to the substrate with no visible damage
F-15 Speed Brake	Wash Primer, followed by polyurethane, finished with antistatic topcoat (15 mils total)	Fiberglass	Hand Sanding	0.3	Extremely time consuming and substrate damage often noted	33	9.1	Coatings removed to primer with no visible substrate damage
P-3 Radome	Epoxy primer and polyurethane topcoat (10 mils total)	Polyester fiberglass	Hand Sanding	3.0	Extremely time consuming and substrate damage often noted	23	12.3	100% removal of topcoat and primer with no visible substrate damage
SH-60 Helicopter Blade	Polyurethane	Titanium, fiberglass, and carbon graphite matrix	Hand Sanding	TBD	Fiber waste is not contained and sanding process is not worker friendly	26	29.0	Coating removed to primer with no visible substrate damage
						35	9.0	Coating removed to substrate with no visible damage
HMMWV Hood	CARC coating	Fiberglass	TBD	TBD	TBD	38	19.6	Coating removed to primer (with some primer removed) with no visible substrate damage

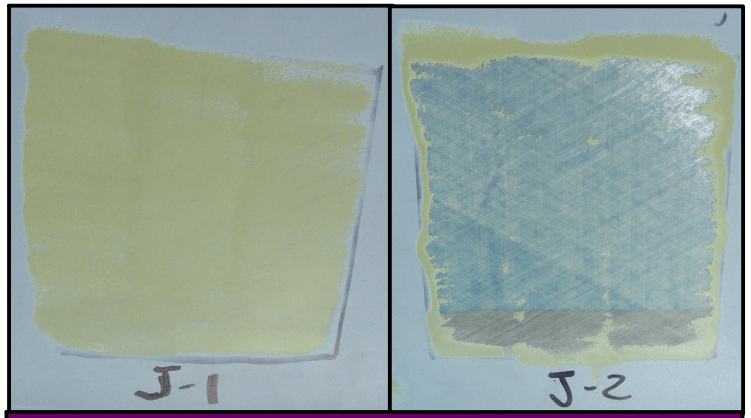
Accomplishments and Results (cont.)

F-15 speed brake
(prior to coating removal)



Coating removed to the primer at a rate of 9.1 ft²/hr with no resulting visible substrate damage

SH-60 helicopter blade
(prior to coating removal)

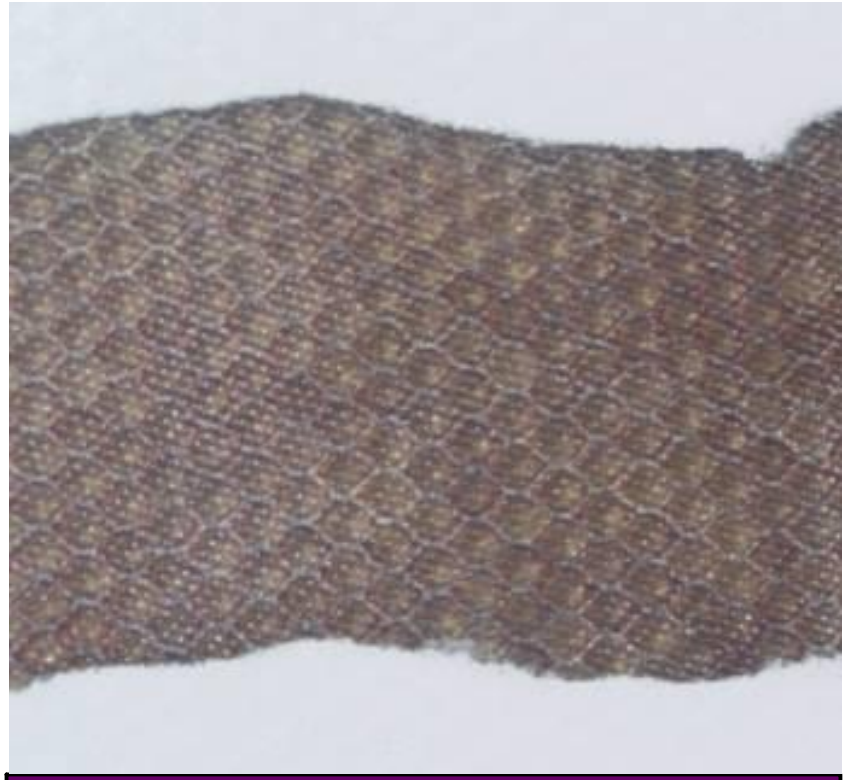


Coating removed to the primer (left) at a rate of 29 ft²/hr and to the substrate (right) at a rate of 9 ft²/hr, with no resulting visible substrate damage in either case

Proof-of-Concept Evaluation – NS Mayport

CHP Coatings Removal Results

P-3 Radome Panel



Coating removed from P-3 radome panel at a rate of 12 ft^2/hr with no visual damage

C-130 Spinner Cap

Coating removed from C-130 spinner cap at a rate of 10 ft^2/hr with no visual damage to the substrate or embedded electrical wires

Economic Analysis

- Level 1 Environmental Cost Analysis Methodology (ECAM[SM])
  - Labor, Materials, Utilities

	Component				
	C-130 Spinner	F-15 Speed Brake	P-3 Radome	SH-60 Helicopter Blade	MK-92 Radome
Annual Operating Cost Savings	$1,627,309	$198,026	$38,666	$19,510	$56,991

- C-130 Spinner
  - 1,040 components/year; 9 ft^2/spinner
  - 16 hrs per component (hand sanding) → less than one hr with CHP
- MK-92 Radome
  - 10 radomes/year; 250 ft^2/radome
  - 62 hrs per radome (hand sanding) → less than 8 hrs with CHP
- SH-60 Helicopter Blade
  - Hand sanding completed only on select portions of the blades at NS Mayport
  - Significant cost savings anticipated at U.S. Army maintenance/rework facilities

Demonstration – NSB Kings Bay

- Based on the successful proof-of-concept evaluation, personnel in attendance from NSB Kings Bay – Trident Refit Facility (TRF) requested a CHP demonstration at their facility
- The NDCEE, in cooperation with ADM, Midvale, and Kings Bay personnel, conducted a CHP demonstration at NSB Kings Bay - TRF on March 21-22, 2006
- The following components were evaluated:
  - Ice Cap
  - NSS Window
  - Sail Window
  - Clam Shell Hatch
  - Ship's Big Eye Yoke
  - Ship's Big Eye Body

Accomplishments and Results (cont.)

- The following results were obtained during the demonstration:

Component	Coating System	Substrate	BASELINE PROCESS			CHP		
			Process	Strip rate (ft^2/hr)	Comments	Nozzle Pressure (psi)	Strip rate (ft^2/hr)	Observations
Ice Cap	Epoxy primer and antifoulant topcoat ("Mare Island" 150/151)	Fiberglass (polyester)	Hand Sanding or PMB	~0.7 (hand sand) ~5.4 (PMB)	8 hours to hand sand or 1 hour to remove with PMB, but PMB causes significant substrate damage)	27	5.6	Antifoulant topcoat removed to the primer with no visible damage
NSS Window	Epoxy primer and antifoulant topcoat	Kevlar	PMB and hand sanding	~10.3 (PMB) Hand sand and repair steps still required	1 hour to remove coatings with PMB and then hand sand select areas, followed by several steps of repair due to substrate damage	23	25.7	Antifoulant topcoat removed to the primer with no visible damage
Sail Window	Epoxy primer and antifoulant topcoat	Fiberglass	PMB	~8.4 (PMB)	4 hours to remove one side of coatings with PMB, but significant substrate resulting damage	40	34.4	Antifoulant topcoat removed to the primer with no visible damage
Clam Shell Hatch	Epoxy primer and antifoulant topcoat ("Mare Island" 151/153)	Fiberglass	Hand Sanding	~5.1 (hand sand)	1 hour to hand sand	28	4.3	Layered coating remaining - would need to optimize CHP process for this application

- NSB Kings Bay media blasting operators participated in CHP coating removal activities. The transition from PMB to CHP was seamless and the process was deemed easily transferable
- Following the demonstration, Midvale supplied NSB Kings Bay with CHP media and a specialized blast nozzle to further familiarize themselves with the technology
- Cost analysis in progress

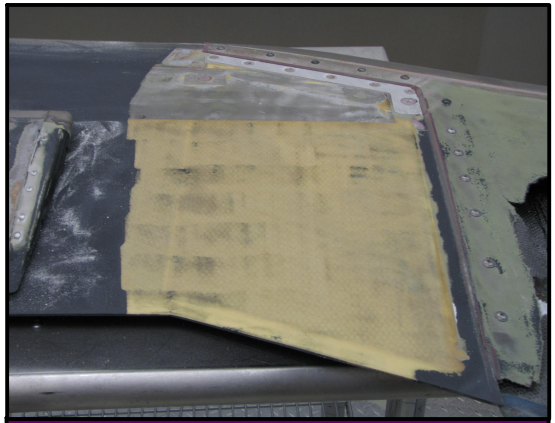
Accomplishments and Results (cont.)

- Conducted demonstration of CHP coatings removal process on select delicate U.S. Army helicopter substrates on August 22-24, 2006 at Helispec facility in Brantley, AL
  - Coordinated with:
    - AMCOM
    - Fort Rucker Aviation Center Logistics Command (ACLC)
    - U.S. Army Research, Development, and Engineering (RD&E) Command
    - CCAD
- The following components were evaluated:
  - UH-60 Rotor Blade (Kevlar)
  - OH-58 Radio Compartment Door (aluminum)
  - OH-58 Pilot Door (aluminum)
  - OH-58 Cowling Cover (fiberglass)
  - UH-1H Tail Rotor Blade (honeycomb aluminum)
  - UH-1H Elevator Skin (aluminum)
- Coatings removed at acceptable rates (per Fort Rucker ACLC and U.S. Army RD&E Command feedback) with no visible substrate damage

Accomplishments and Results (cont.)

UH-60 rotor blade
(prior to coating removal)

Coatings removed to Kevlar substrate at a rate of 34.4 ft^2/hr with no substrate damage



Coatings removed from Kevlar as well as a section of aluminum lightning mesh

Accomplishments and Results (cont.)

Implementations

- United States Coast Guard (USCG) Aircraft Repair and Supply Center (ARSC)
  - Elizabeth City, NC
  - Implemented CHP coatings removal as PMB replacement in 2003
  - Four aircraft lines (search and rescue helicopters): HC-130, HH-60J, HU25, HH-65
- Other facilities have initiated the necessary preparations for implementation:
  - NSB Kings Bay
    - CHP media and specialized nozzle remained in blast booth following demonstration activities
    - NSB Kings Bay blasting personnel used CHP media during coatings removal activities; more CHP media was purchased
  - NS Mayport
    - Installing two new blast booths, both of which are to be dedicated to CHP coatings removal
  - NADEP - Jacksonville
    - Conducting additional assessments on CHP coatings removal technology
  - Robins AFB
    - Installing two new booths for CHP coatings removal

Path Forward

- Complete final demonstration and validation (dem/val) of CHP coating removal on select delicate substrates (October 16-25, 2006)
  - P-3 Radome
  - C-130 Talon II Radome
  - UH-60 Rotor Blade
  - HMMWV Hood
  - PCMS Tiles
  - MK-92 Radome
- Complete Level 2 ECAM based on final dem/val results
- Identify all implementation needs at each facility and assist in the facilitation and execution of planning activities

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- NSWCCD
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- NASA AP2
- TACOM
- AMCOM
- U.S. Army RD&E Command
- USMC

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